Review of Yerington Mine Characterization Activities

December 9, 2004

Addendum 1
February 18, 2005

Radiological Laboratory Results for Soil Samples Collected During the Yerington Mine Characterization Activities Review.

Prepared for:

United States Department of the Interior
Bureau of Land Management
Nevada State Office

Prepared by:

Technical Resources Group, Inc.
Idaho Falls, Idaho

Sample Collection

During the December 9, 2004, Yerington Mine site visit, three grab samples of surface soil were collected for laboratory analysis. One sample was collected from the basin of Slot Pond 2 near the pump station; two other samples were collected from the mine processing area. The purpose for conducting laboratory analysis on the soil samples was to evaluate the isotopic mixtures and concentrations of naturally occurring radionuclides associated with the elevated radiation levels observed in and around the site.

As described in the main report, soil sample 7, collected from the Slot Pond 2 basin, consisted primarily of sandy-like soil and fine gravel. The measured radiation levels around the surface edge of the pond were consistent with background levels. A majority of the pond basin was covered in ice as shown in Figure 7. Therefore, only one soil sample was initially collected from the pond area.

While conducting general radiation surveys in the process area, several discrete locations were determined to have elevated radiation levels. Based on the radiation measurements observed and recorded in Table 2 of the main report, two soil samples were collected from the process area. Soil sample 8 was collected from an access trench near the iron launders. Soil sample 9 was collected from surface soil located near the iron launders. These sample locations are identified in Figure 4 of the main report. The sample locations and radiation measurements data are shown in Table-1 of the main report.

Laboratory Analyses

Soil samples were collected as grab samples into freezer bags and then double bagged to secure the samples during handling and transport. A copy of the sample analysis request form and chain of custody are provided in Appendix A of this addendum. The samples were shipped to Paragon Analytics in Fort Collins, Colorado, for radioanalytical analyses. The requested analyses included isotopic and total uranium, isotopic thorium, and radium- 226 and radium-228. The laboratory analyses and reference methods are shown in **Table A-1**.

As shown in **Table A-1**, the uranium and thorium analyses were performed using radiochemical separation and then analyzed by alpha spectrometry. For uranium analyses, the total uranium concentration was also requested to allow for comparison with previous sampling projects conducted at the Yerington Mine.

The radium-226 and radium-228 (Ra-226 and Ra-228) analyses were performed using traditional gamma spectrometry. An aliquot of 500 grams was removed from each sample and sealed into individual containers and held for approximately 27 days prior to analysis. This process allowed for equilibrium to be reached between the Ra-226 and the short-lived decay daughters of radon-222 (Rn-222, including the in-growth of bismuth-214 (Bi-214) and lead-214 (Pb-214). The Ra-228 concentrations were determined based on the measured concentration of actinium-228 (Ac-228). During gamma spectrometry analysis, other gamma-emitting radionuclides present in the sample can be identified and reported by the laboratory. Specifically, the concentrations of naturally occurring, radioactive potassium-40 (K-40) have been reported with the Ra-226 and Ra-228 results.

Table A-1. Laboratory analyses and reference methods

Radiological Parameter	Analysis	Reference Method
Uranium - Isotopic	Alpha Spectrometry	ASTM D3972-90M
Thorium - Isotopic	Alpha Spectrometry	ASTM D3972-90M
Radium -226/228 (Bi/Pb-214 ingrowth)	Gamma Spectrometry	EPA 901.0M

Sample Results

The individual analysis results are reported in **Tables A-2** through **A-4**. The results are reported in radioactivity concentration of picoCurie per gram (pCi g^{-1}) of dry soil, with the total propagated uncertainty expressed as plus or minus 2-sigma (±2s). The reported 2-sigma values represent the 95 percent confidence interval for the reported measurement value. For example, if a measurement was reported as 10 pCi g^{-1} ± 0.1, there is 95 percent confidence that the actual value is between 9.9 pCi g^{-1} and 10.1 pCi g^{-1}. When reported with the measured value, the 2-sigma uncertainty expresses the variability in an individual measurement that occurs from radioactive decay, instrumentation, and chemical recovery of the sample material.

The minimum detectable concentration (MDC) is also reported for each sample analysis result shown in the tables. The MDC is the minimum radioactivity concentration (pCi g^{-1}) that can be identified with 95 percent confidence under the laboratory's specified set of measurement conditions. If the reported concentration is less than the MDC value, the nuclide may be present in concentrations that are below the analytical capability to measure. When this occurs, the laboratory will report a measured concentration value but also note that the value was less than the MDC.

Table A-2 contains a summary of isotopic and total uranium concentration measured in the samples. The total uranium concentrations are reported as the sum of the individual isotopes (U-234, U-235 and U-238), combined with the 2-sigma uncertainty. Uranium which is found naturally in all rocks and soil consists of the three isotopes, U-234, U-235, and U-238. Of these isotopes, U-238 accounts for approximately 99.28 percent of the total mass of uranium, but is usually observed in radioactive equilibrium or near equilibrium with U-234 which accounts for only 0.0058 percent of the mass. U-235 accounts for about 0.71 percent of natural uranium. For comparison, U-238 concentrations observed in common rock types can range from 0.5 to 4.7 ppm or 0.2 to 1.6 pCi g^{-1}. For surface soils, the average U-238 concentration is approximately 1.8 ppm or 0.6 pCi g^{-1}(Eisenbud and Gesell,1997).

The uranium concentrations reported for sample 7 appear to be characteristic of near background or natural concentrations of uranium observed in surface soils. In comparison, samples 8 and 9 collected from the process area of the mine appear to be higher in concentrations of uranium. Although this sampling event included only three samples from the entire site, these results suggest that the isotopic ratios of uranium are similar among the three samples. In particular, U-234 and U-238 concentrations appear to be in radioactive equilibrium for each of the samples collected.

Table A-2 Uranium concentrations in grab soil samples as measured by alpha spectroscopy

Sample ID #	Nuclide	Soil Concentration pCi g^{-1} ± 2s	MDC pCi g^{-1}
Yerington 7	U-234	1.21 ± 0.23	0.03
	U-235	0.038 ± 0.027	0.022
	U-238	1.07 ± 0.21	0.02
	U_{Total}	2.32 ± 0.31	0.04
Yerington 8	U-234	4.81 ± 0.89	0.15
	U-235	0.36 ± 0.16	0.12
	U-238	4.41 ± 0.83	0.10
	U_{Total}	9.6 ± 1.2	0.2
Yerington 9	U-234	3.46 ± 0.65	0.06
	U-235	0.180 ± 0.097	0.033
	U-238	3.44 ± 0.65	0.08
	U_{Total}	7.08 ± 0.93	0.09

The isotopic thorium analyses results are reported in **Table A-3**. The naturally occurring isotopes of thorium are found in the common rock types and soil. The primary thorium decay series originates with thorium -232 (Th-232). Th-232 concentrations have been reported to range from 1.6 to 20 ppm or 0.2 to 2 pCi g^{-1} in common rock types. The average concentration of Th-232 observed in soils is approximately 1 pCi g^{-1} (NCRP. 1987). Thorium-228 (Th-228) occurs in nature as a decay nuclide in the Th-232 decay series (see **Table A-5**). Th-228 will occur in radioactive equilibrium or near equilibrium with Th-232 from samples collected in rocks and soil. Thorium-230 (Th-230) is located in the U-238 decay series as a decay daughter of U-234 (see T**able A-6)**. Th-230 will also occur in equilibrium with U-238 when sampled from undisturbed rocks and soil.

As part of the thorium decay series, Th-228 concentrations did not appear to be in equilibrium with Th-232 for samples 8 and 9. A possible explanation for this disequilibrium may be the concentrations of Ra-228 observed in samples 8 and 9. As shown in **Table A-5**, the concentrations of Ra-228 in samples 8 and 9 were higher than the reported Th-232 concentrations, but similar to the thorium-228 concentrations.

The concentration of Th-230 for sample 7 collected from the Slot Pond Basin appeared to be in equilibrium with the parent nuclides U-234 and U-238. For samples 8 and 9 collected from the process area, the concentrations of Th-230 are significantly higher than the reported concentrations of U-234 and U-238. However as shown in Table A-4, Radium-226 (Ra-226) a decay daughter of Th-230, had concentrations that were significantly higher than both the parent nuclides of Th-230 and U-234 for samples 8 and 9.

Table A-3 Isotopic thorium concentrations in grab soil samples as measured by alpha spectroscopy

Sample ID #	Nuclide	Soil Concentration pCi g^{-1} ± 2s	MDC pCi g^{-1}
Yerington 7	Th-228	0.92 ± 0.22	0.10
	Th-230	1.70 ± 0.35	0.10
	Th-232	0.75 ± 0.18	0.04
Yerington 8	Th-228	31.9 ± 8.2	4.8
	Th-230	77 ± 16	5
	Th-232	17.1 ± 5.1	1.7
Yerington 9	Th-228	49 ± 11	6
	Th-230	127 ± 24	5
	Th-232	24.8 ± 6.4	1.5

Ra-226 is typically found in approximate equilibrium with U-238. The typical concentrations found in rocks and soils will be similar to those values reported earlier for U-238. As discussed previously, the Ra-226 concentrations for samples 8 and 9 collected in the mine process area are significantly higher than the parent nuclides, Th-230 and U-234. For undisturbed soils, the concentrations of Ra-226 should be in approximate equilibrium with U-234 and U-238. The remaining nuclides in the U-238 decay series including radon-222 (Rn-222) and its short-lived daughter-products will be in equilibrium with Ra-226.

As presented, the data confirms that both Ra-226 and Th-230 are not in equilibrium with the parent isotopes of U-234 and U-238. Based on the laboratory results provided, the elevated radiation levels observed in samples 8 and 9 in the mine process area can be attributed to the high concentrations of Ra-226 and Rn-222 decay daughters. The concentration of 9300 pCi g^{-1} for Ra-226 in sample 9 is significantly higher than the parent nuclides, Th-230 and U-234. The Th-230 concentration in sample 9 was 127 pCi g^{-1}, while the concentration of U-234 was 3.46 pCi g^{-1}.

The Ra-228 concentrations reported in **Table A-4** are based on the measured concentrations of Actinium-228 (Ac-228). Where Ac-228 has a short half-life (6-hours), relative to the Ra-228 half-life (5-years), the radioactivity of Ac-228 will be equal to the parent radioactivity of Ra-228. Potassium-40 (K-40) was detected in concentrations above the MDC in sample 7. However, the reported concentrations of K-40 in samples 8 and 9 did not exceed the MDC identified in **Table A-4**.

Table A-4 Ra-226, Ra-228 and K-40 concentrations in grab soils as measured by gamma spectroscopy

Sample ID #	Nuclide	Soil Concentration pCi g^{-1} ± 2s	MDC pCi g^{-1}
Yerington 7	Ra-226	2.78 ± 0.52	0.61
	Ra-228	0.82 ± 0.77[a]	1.19
	K-40	20.8 ± 5.1	3.6
Yerington 8	Ra-226	4550 ± 530	10
	Ra-228	24.6 ± 7.3	14.6
	K-40	37 ± 29	46[a]
Yerington 9	Ra-226	9300 ± 1100	0
	Ra-228	56 ± 16	28
	K-40	24 ± 50	83[a]

[a] Sample result was less than the MDC

Tables A-5 and **A-6** were developed to demonstrate the correlation of the Th-232 and U-238 decay series nuclides in relationship to the nuclide concentrations measured in the three soil samples. The first column contains the parent nuclide and the primary decay nuclides that have a half-life greater than a few minutes, or that can be routinely measured in environmental samples. The second column contains the radioactive half-live of the nuclide expressed in the appropriate time units of years (y), hours (h), and minute (m). The remaining columns display the nuclide concentrations measured in each soil sample.

When the parent half-life is relatively long in comparison to its decay daughter, the nuclides are considered to be in secular equilibrium. In the case of Th-232 as shown in **Table A-5**, the decay-series nuclides would typically be found in approximate equilibrium in rocks and soils found in nature. The concentrations of U-238, Th-232, and associated decay nuclides measured in sample 7 were similar to the equilibrium expected from natural rocks and soils. As expected, copper extraction activities at the Yerington Mine have chemically separated and therefore altered the equilibrium relationship of natural nuclides as shown by samples 8 and 9 collected from the mine process area.

In the case of the Th-232 decay series, the concentration of Ra-228 and the remaining decay nuclides are expected and appeared to be in equilibrium for all three samples. However for samples 8 and 9, the Ra-228 and remaining decay nuclides may not be in equilibrium with the

parent nuclide, Th-232. During active operations at the mine site, Ra-228 has most likely been chemically separated from the Th-232. Since operations have discontinued at the site, the abundance of Ra-228 above the measured concentrations of Th-232 is continually decreasing. After approximately seven half-lives (35 years since operations ceased), the remaining Ra-228 will be in equilibrium with the remaining Th-232. This observation suggests that future sampling for Th-232 concentrations can be accomplished by measuring the Ra-228 and associated decay-daughter concentrations.

For the U-238 decay series shown in **Table A-6**, a similar correlation can be observed as the Th-232 decay series. The Ra-226 concentrations are expected and appear to be in equilibrium with the remaining decay daughters as shown for samples 7, 8, and 9. The Ra-226 half-life (1600 years) is relatively long in comparison to the remaining decay nuclides. For sample 7, the concentrations of U-238 and the remaining nuclides are essentially in equilibrium. In samples 8 and 9, the Ra-226 concentrations are significantly higher than the parent nuclides of Th-230, U-234, and U-238. Additionally, the Th-230 concentrations are higher than the reported U-234 and U-238 concentrations.

As shown in **Table A-6**, the Ra-226 and Th-230 nuclides have been separated at some point from the U-234 and U-238 parent nuclides and then concentrated in the waste processing. Along with the elevated concentrations observed, the relatively long half-life of Ra-226 (1,600 y) and Th-230 (7.7E + 04 y) may require that future sampling efforts include specific analysis for these nuclides, with the U-238. Additionally, it may be helpful to review the historical sampling data for consistency as this report only included the three samples.

One observation that may be unclear at this point in time is why the concentrations of U-238 and U-234 appear to be significantly less than the Th-230 and Ra-226 concentrations. Samples 8 and 9 were collected in the process area of the mine and most likely represent waste effluent that was either spilled or leaked from associated piping and waste handling activities. A question still remains as to why the uranium concentrations were so low in comparison to the observed Ra-226 and Th-230 in the process area. It is not clear at this time if the majority of uranium remained suspended in the copper leached ore, or whether it remained in solution and traveled to the evaporation ponds. As mentioned above, it may be useful to review the historical sampling data and process information to prioritize future sampling efforts.

Recommendations

Sample results presented in this report provided preliminary data for evaluating nuclide mixture and concentration of naturally occurring radioactivity. The majority of elevated radiation levels observed in the waste processing area can be attributed to the high concentrations of Ra-226 and associated decay nuclides identified in the soil sample analyses.

As discussed in the main report, the elevated radiation levels were observed in discrete locations around the processing area. Ra-226 and the short lived nuclides of Rn-222 appear to be the main contributors to the external radiation levels measured in the process area. For future characterization activities in the mine process area, it may be possible to develop a correlation between a measurable radiation exposure rate to an expected concentration of Ra-226 (including decay nuclides) in soil. This correlation could allow for screening surface soils and building debris in the process area using survey instrumentation. Radiation surveys appear to be a more appropriate method for identifying and evaluating the discrete soil contamination areas and associated building debris within the process area.

As summarized in this sampling report, future soil sampling efforts should include specific analyses for Ra-226, and Ra-228. Additionally, the Th-230 concentrations were observed in higher concentrations than the U-234, but lower than Ra-226. It may be necessary to analyze for Th-230 specifically or determine from previous sampling data if the concentrations of Ra-226 will always bound (be higher) than the observed Th-230 concentrations.

Also, it was suggested in this report that U-238 and U-234 were significantly lower in concentration than expected. With a significantly higher concentration of Th-230 and Ra-226 measured in samples collected from mine process area, it was not clear as to whether a majority of the uranium was not chemically separated from the ore, or whether it continued in solution to the evaporation or waste ponds. This discrepancy should be evaluated in more detail to identify future sampling objectives.

Table A-5 Th-232 decay series with the soil concentration for the major nuclides

Nuclide	Radioactive Half- Life	Soil Concentrations pCi g^{-1} ± 2s		
		Sample 7	Sample 8	Sample 9
Th-232	1.40E+10 y	0.75 ± 0.18	17.1 ± 5.1	24.8 ± 6.4
Ra-228	5.75 y	0.82 ± 0.77	24.6 ± 7.3	56 ± 16
Ac-228	6.13 h	0.82 ± 0.77	24.6 ± 7.3	56 ± 16
Th-228	1.9 y	0.92 ± 0.22	31.9 ± 8.2	49 ± 11
Ra-224	3.66 d			
Pb-212	10.64 h	1.24 ± 0.35	34.9 ± 6.0	35.6 ± 9.6
Bi-212	60.55 m	2.8 ± 2.3	32 ± 38	88 ± 62
Tl-208	3.07 m	0.35 ± 0.22	9.1 ± 2.2	20.8 ± 5.5
Pb-208	Stable			

Table A-6. U-238 decay series with the soil concentration for the major nuclides

Nuclide	Radioactive Half- Life	Soil Concentrations pCi g^{-1} ± 2s		
		Sample 7	Sample 8	Sample 9
U-238	4.47E + 09 y	1.07 ± 0.21	4.41 ± 0.83	3.44 ± 0.65
Th-234	24.1 d			
Pa-234m	1.17 m			
U-234	244500 y	1.21 ± 0.23	4.81 ± 0.89	3.46 ± 0.65
Th-230	7.70E+04 y	1.70 ± 0.35	77 ± 16	127 ± 24
Ra-226	1600 y	2.78 ± 0.52	4550 ± 530	9300 ± 1100
Rn-222	3.823 d			
Po-218	3.05 m			
Pb-214	26.8 m	2.55 ± 0.52	3570 ± 420	7200 ± 840
Bi-214	19.9 m	1.75 ± 0.53	3420 ± 400	6600 ± 770
Tl-210	1.3 m			
Pb-210	22.3 y			
Bi-210	5.01 d			
Po-210	138 d			
Pb-206	Stable			

References

Eisenbud, M., and Gesell, T. (1997). Environmental radioactivity from natural, industrial, and military sources., Fourth Addition.

NCRP (1987). Exposure of the population of the United States and Canada from natural background radiation. Report 94. National Council on Radiation Protection and Measurements, Bethesda, Maryland.

Appendix A to Addendum 1

TECHNICAL RESOURCES GROUP, INC. SOIL/WATER SAMPLE
Sheet 1 of 1
CHAIN OF CUSTODY RECORD

0412180

Project No: YM-120904

Laboratory Destination: Paragon Analytics

Sample Collected By (signature): [signature]

Sample Number Field / Laboratory	Sampling Date Date / Time	Matrix / Volume	Analysis Requested	Preservation	Remarks
Yerington #7 (1)	12-9-04 / 1135	Soil (solid) Approx 1300 grams	Total U; Isotopic U, Th; Ra 226/228 gamma spec.	N/A	
Yerington #8 (2)	12-9-04 /1325	Soil (solid) Approx 1300 grams	Total U; Isotopic U, Th; Ra 226/228 gamma spec.	N/A	
Yerington #9 (3)	12-9-04 /1335	Soil (solid) Approx 1300 grams	Total U; Isotopic U, Th; Ra 226/228 gamma spec.	N/A	
Condition of Samples Upon Receipt at the Lab: Custody Seals intact? Yes No No seal			**Received for Lab by:**		**Special Instructions:** Please return copy of form

Signature: (Name, Date and Time)

1. Relinquished by [signature] 12/17/04 1530 Received by [signature]
   Condition of seal _____ Condition of seal Intact
2. Relinquished by _____ Received by _____
   Condition of seal _____ Condition of seal _____
3. Relinquished by _____ Received by _____
   Condition of seal _____ Condition of seal _____

Radiological Survey

Gamma max 2.0 mR/hr

Contamination <1,000 dpm/100 cm² fix

Surveyed by: (signature, date, time)
[signature] 12/17/04 1500

Paragon Analytics

CONDITION OF SAMPLE UPON RECEIPT FORM

Client: Tech Res Group Workorder No: 0412180

Project Manager: JE Initials: CMG Date: 12-20-07 12-20-07 CMG

1. Does this project require any **special handling** in addition to standard Paragon procedures?		YES	NO
2. Is **pre-screening** required per SOP 008?		YES	NO
3. Are custody **seals** on **shipping containers** intact?	N/A	YES	NO
4. Are custody **seals** on **sample containers** intact?	N/A	YES	NO
5. Is there a **COC (Chain-of-Custody) present** or other representative documents?		YES	NO
6. Is the **COC** (if applicable) **complete and legible**?	N/A	YES	NO
7. Are **bottle IDs legible** and in **agreement** with **COC sample IDs**?	N/A	YES	NO
8. Is the COC in agreement with samples received? (**# of samples, # of containers, matrix**)	N/A	YES	NO
9. Were **airbills** present and/or removable?	N/A	YES	NO
10. Are all **aqueous samples** requiring preservation **preserved correctly**? (excluding volatile organics)	N/A	YES	NO
11. Are all aqueous **non-preserved samples** at the **correct pH**?	N/A	YES	NO
12. Is there **sufficient sample** for the requested analyses?		YES	NO
13. Were all samples placed in the **proper containers** for the requested analyses?		YES	NO
14. Are all samples within **holding times** for the requested analyses?		YES	NO
15. Were all sample containers received **intact**? (not broken or leaking, etc.)		YES	NO
16. Are all samples requiring no headspace (volatiles, reactive cyanide/sulfide, radon), headspace free? **Size of bubble**: ____ < green pea ____ > green pea	N/A	YES	NO
17. Were samples checked for and free from the presence of **residual chlorine?** (Applicable when PM has indicated samples are from a chlorinated water source; note if field preservation with sodium thiosulfate was not observed.)	N/A	YES	NO
18. Were the sample(s) **shipped on ice**?	N/A	YES	NO
19. Were cooler temperatures measured at 0.1-6.0°C?	N/A	YES	NO

***IR gun used** *(circle one)*: **#2** - Oakton InfraPro II, SN2922500201-0066; **#4** - Oakton InfraPro II, SN2372220101-0002

Cooler #'s	1							
Temperature (°C)	Ambient							
No. of custody seals	0							
DOT Survey/ Acceptance Information: External µR/hr reading	350							
DOT Survey/ Acceptance Information: Background µR/hr reading	12							

Were external µR/hr readings ≤ two times background and within DOT acceptance criteria? **YES** / **NO** (If no, see Form 008.)

Additional Information: PROVIDE DETAILS BELOW FOR A NO RESPONSE TO ANY QUESTION ABOVE EXCEPT #1 AND #2.

- Internal custody seals on Bottles intact
- #1 - 150 mR/hr
- #2 - 500 mR/hr
- #3 - 1 mR/hr

If applicable, was the client contacted? **YES / NO / NA** Contact Name:_____ Date/Time:_____

Project Manager Signature/ Date: 12/20/07

Form 201r18.xls (6/26/04)

Page 1 of 1

Total Uranium by Alpha Spectroscopy Sample Results Summary

Client Name: Technical Resource Group
Client Project Name:
Client Project Number: YM-120904

Laboratory Name: Paragon Analytics
PAI Work Order: 0412180

Reported on: Thursday, January 27, 2005 12:05:48 PM

Lab Sample ID	Client Sample ID	Sample Type	Nuclide	Result +/- 2 s TPU	MDC	Units	Matrix	Prep Batch	Date Analyzed	Flags
0412180-1	Yerington #7	Sample	U-234	1.21 +/- 0.23	0.03	pCi/g	SOIL	AS050103-4	1/13/2005	
0412180-1	Yerington #7	Sample	U-235	0.038 +/- 0.027	0.022	pCi/g	SOIL	AS050103-4	1/13/2005	LT
0412180-1	Yerington #7	Sample	U-238	1.07 +/- 0.21	0.02	pCi/g	SOIL	AS050103-4	1/13/2005	
0412180-1	Yerington #7	Sample	URANIUM, TOTAL	2.32 +/- 0.31	0.04	pCi/g	SOIL	AS050103-4	1/13/2005	
0412180-2	Yerington #8	Sample	U-234	4.81 +/- 0.89	0.15	pCi/g	SOIL	AS050119-3	1/22/2005	M3
0412180-2	Yerington #8	Sample	U-235	0.36 +/- 0.16	0.12	pCi/g	SOIL	AS050119-3	1/22/2005	M3
0412180-2	Yerington #8	Sample	U-238	4.41 +/- 0.83	0.10	pCi/g	SOIL	AS050119-3	1/22/2005	
0412180-2	Yerington #8	Sample	URANIUM, TOTAL	9.6 +/- 1.2	0.2	pCi/g	SOIL	AS050119-3	1/22/2005	M3
0412180-3	Yerington #9	Sample	U-234	3.46 +/- 0.65	0.06	pCi/g	SOIL	AS050125-9	1/26/2005	

Comments:

Data Package ID: *ut0412180-1*

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

LT - Result is less than Requested MDC, greater than sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M - The requested MDC was not met.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Total Uranium by Alpha Spectroscopy Sample Results Summary

Client Name: Technical Resource Group
Client Project Name:
Client Project Number: YM-120904

Laboratory Name: Paragon Analytics
PAI Work Order: 0412180

Reported on: Thursday, January 27, 2005 12:05:48 PM

Lab Sample ID	Client Sample ID	Sample Type	Nuclide	Result +/- 2 s TPU	MDC	Units	Matrix	Prep Batch	Date Analyzed	Flags
0412180-3	Yerington #9	Sample	U-235	0.180 +/- 0.097	0.033	pCi/g	SOIL	AS050125-9	1/26/2005	
0412180-3	Yerington #9	Sample	U-238	3.44 +/- 0.65	0.08	pCi/g	SOIL	AS050125-9	1/26/2005	
0412180-3	Yerington #9	Sample	URANIUM, TOTAL	7.08 +/- 0.93	0.09	pCi/g	SOIL	AS050125-9	1/26/2005	

Comments:

Data Package ID: *ut0412180-1*

Qualifiers/Flags:

U - Result is less than the sample specific MDC.
LT - Result is less than Requested MDC, greater than sample specific MDC.
Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
Y2 - Chemical Yield outside default limits.
M - The requested MDC was not met.
M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)
MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Isotopic Thorium By Alpha Spectroscopy Sample Results Summary

Client Name: Technical Resource Group
Client Project Name:
Client Project Number: YM-120904

Laboratory Name: Paragon Analytics
PAI Work Order: 0412180

Reported on: Monday, January 17, 2005 7:54:41 AM

Lab Sample ID	Client Sample ID	Sample Type	Nuclide	Result +/- 2 s TPU	MDC	Units	Matrix	Prep Batch	Date Analyzed	Flags
0412180-1	Yerington #7	Sample	Th-228	0.92 +/- 0.22	0.10	pCi/g	SOIL	AS050103-3	1/12/2005	
0412180-1	Yerington #7	Sample	Th-230	1.70 +/- 0.35	0.10	pCi/g	SOIL	AS050103-3	1/12/2005	
0412180-1	Yerington #7	Sample	Th-232	0.75 +/- 0.18	0.04	pCi/g	SOIL	AS050103-3	1/12/2005	
0412180-2	Yerington #8	Sample	Th-228	31.9 +/- 8.2	4.8	pCi/g	SOIL	as050103-5	1/14/2005	M3
0412180-2	Yerington #8	Sample	Th-230	77 +/- 16	5	pCi/g	SOIL	as050103-5	1/14/2005	M3
0412180-2	Yerington #8	Sample	Th-232	17.1 +/- 5.1	1.7	pCi/g	SOIL	as050103-5	1/14/2005	M3
0412180-3	Yerington #9	Sample	Th-228	49 +/- 11	6	pCi/g	SOIL	as050103-5	1/14/2005	M3
0412180-3	Yerington #9	Sample	Th-230	127 +/- 24	5	pCi/g	SOIL	as050103-5	1/14/2005	M3
0412180-3	Yerington #9	Sample	Th-232	24.8 +/- 6.4	1.5	pCi/g	SOIL	as050103-5	1/14/2005	M3

Comments:

Data Package ID: *th0412180-1*

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

LT - Result is less than Requested MDC, greater than sample specific MDC.

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M - The requested MDC was not met.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit